

2 hours and $2\frac{1}{2}$ hours respectively. The evidence and confirmation place it beyond reasonable doubt that the links shown are realities, and though they supply us with vastly extended knowledge of the dimensions, and form, and details of this nebula, yet leave us with unsatisfied desire to see more, and probably to find that the nebula will be shown to have a symmetrical form in external outline, but is in a state of strong internal commotion. Next year we ought to be able to supply the missing links and see it as a finished picture. In the meantime we ought, with all gratitude, to admire the patient, long-suffering endurance of those martyrs to science, who during the freezing nights of many successive winters plotted, with pencil in benumbed fingers, the crude outlines which have been handed down to us as correct drawings of this wonderful nebula, which we can now depict during four hours of clear sky with far greater accuracy than is possible by the best hand-work in a lifetime.

Note on an Apparatus for correcting the Driving of the Motor Clocks of large Equatorials for long Photographic Exposures.
By A. A. Common, F.R.S.

In giving long exposures in astronomical photography it is absolutely essential that some means be adopted to prevent any shift of the image on the photographic plate during exposure; for if irregularities in clock-driving, changes due to flexure of instrument, and alterations in apparent position due to refraction are not immediately corrected the photograph will be blurred and the fine detail lost. These irregularities are further complicated in the case of reflectors by changes due to alterations of temperature, and by variations of strains in the mirror as the telescope moves round.

There are obviously two methods by which the image of the object to be photographed can be kept in exactly the same position on the plate during exposure: either the telescope itself must be moved by means of its fine screws for slow motion in right ascension and declination, or the photographic plate must be moved during the exposure. The first method has been adopted by the Paris Conference for the instruments to be used in charting the stars. A finder of 9 inches' aperture is to be attached to each photographic instrument, the optic axes to be parallel; and the stars are to be watched throughout the exposure and any shift immediately checked by the slow-motion screws of the instrument. For small instruments this method is perhaps capable of meeting all the difficulties, for the slow motions can be made to work smoothly; but it is impossible to apply it properly to large and heavy instruments, especially to large reflectors where the parallelism of the finder and the axis of the mirror can never be rigidly maintained.

At the meeting of the Society in November 1884 I briefly referred to the apparatus used with the 3-foot reflector at Ealing for moving the photographic plate during exposure, so as to correct for shift; and a similar arrangement having been made for the 5-foot, a description of that in considerable detail is given here.

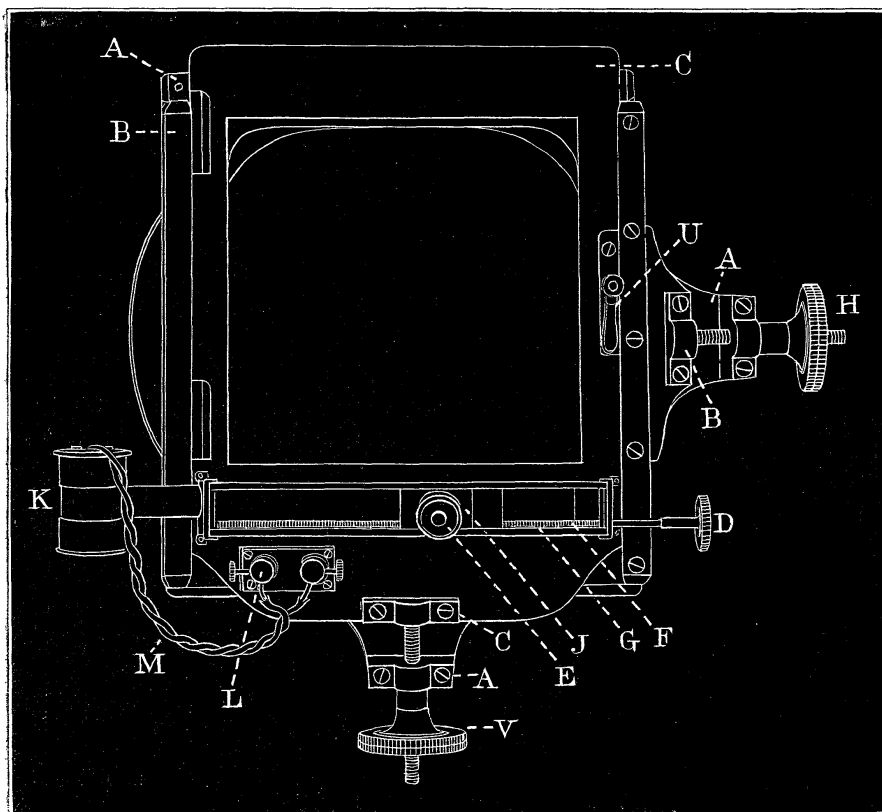


Fig. 1.

Fig. 1 is from a photograph of the apparatus with the plate-carrier detached.

A A A is a plate with three clips behind to attach it rigidly to the eye end of the telescope.

B B is a slide fitting into A and capable of movement in horizontal direction by means of the fine screw at H.

C C is a slide falling into B and capable of movement in a direction at right angles to the movement of B by means of the fine screw at V.

The dark slide is fitted on to the plate C, a small cam, U, serving to fix the dark slide in position. D is the milled head of a fine screw, F, extending the whole length of the box G, the latter being part of the slide C, and having a glass face.

The plate J slides in grooves above the glass face, and has the eyepiece E screwed into it.

On F is fitted a nut, carrying a small ring (under the glass face) with two cross-wires, the intersection of which is exactly

in the focus of E, and also in the plane of the film of the photographic plate. The cross-wires are illuminated from the side by a small incandescent lamp in K, the light being steady and uniform when the current is supplied from one or two storage cells to the screws L and thence through M to the lamp.

Any one of a line of small pinholes through the bottom of the box G can be uncovered by bringing the cross-wires and eyepiece directly over it. Unless the uncovered pinhole is very small there will be danger of light getting through it and on to the photographic plate, the faintest external light falling on the plate for two or three hours being sufficient to fog it.

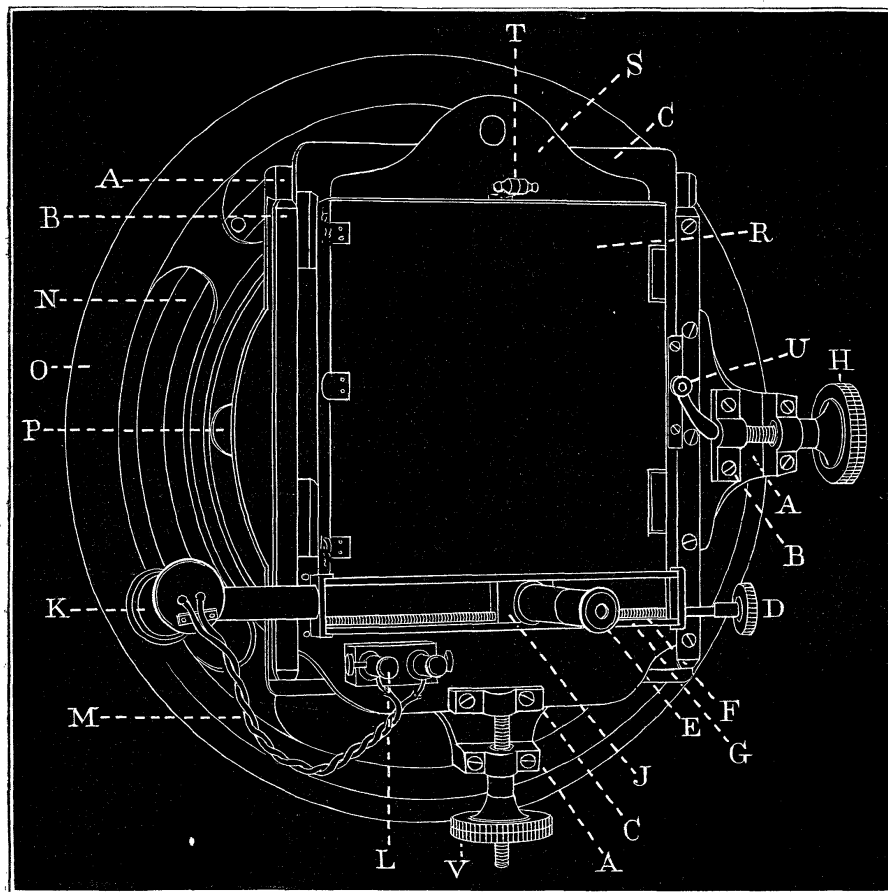


Fig. 2.

Fig. 2 shows the whole eyepiece end of the telescope with the dark slide in position ready for exposure of the plate.

R is the dark slide fitting on to C and fixed to it by U, S is the shutter of ebonite, and T is a small screw which serves to hold the shutter down when the slide is closed, as in figure. and holds it open when the plate is being exposed. N is a ring screwed to the end of the reflector. O is the focussing-wheel, and P one of the three levelling-screws for getting the plate a right angles to the optic axis of the mirror.

In practice, before the exposure is commenced, the apparatus is arranged so that the screw H gives a motion in R.A. to the plate, and V a motion in declination; then any star on the edge of the field is fixed upon and the cross-wires brought directly over it. Throughout the exposure this star is kept under view; the eyepiece being very powerful, the smallest errors become apparent to the eye, and can be corrected at once by the screws. If from any cause it is necessary to discontinue the exposure the plate can be shut up, and the exposure can be recontinued at any time if the guiding star is brought exactly to the cross-wires, for then the plate is in the same position as it was before the interruption. The wires being in exactly the same plane as the film, any alteration of focus can be at once detected in the eyepiece and corrected at once by the focussing-wheel.

Spectroscopic Observations of sundry Stars and Comets, made at the Royal Observatory, Greenwich, chiefly in the years 1887 and 1888. By E. W. Maunder.

(Communicated by the Astronomer Royal.)

I. γ CASSIOPEIÆ and β LYRÆ.

The object of the following observations was to detect any bright lines in the spectra of these two stars, to watch if such lines varied in brightness, and to determine the wave-length of the bright line near the D lines, supposed to be D_3 .

The instruments employed were the half-prism spectroscope, with one half-prism, either in the direct or reversed position, and the single-prism spectroscope, with one large prism of 60° . The dispersions of the three instruments are as follows:—

	A to H.	Power of Eyepiece.
Half-prism spectroscope, Direct	$18\frac{1}{2}$	14
„ „ Reversed	5	30
Single-prism spectroscope	$4\frac{2}{3}$	10

These were mounted on the South-East equatorial, of 12·8 inches' aperture, and were used either with or without a cylindrical lens before the slit.

γ Cassiopeiæ.

Single-prism spectroscope.

Three bright lines were observed, viz. C, F, and a line near D, supposed to be D_3 . These three lines, if seen at all, were seen as bright lines, never as dark.